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Performance of RC Building with Different base Isolators

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Abstract: ***The paper evaluates the application of base isolation methods based on the location of site. Building various sorts of structures while assuring their safety, serviceability, and durability is the focus of civil engineering. Seismic activity has severe impact on the structures' serviceability and safety. The type of building, the type of soil, the technology utilized for seismic resistant, and the location of the building, all the effects how much damage an earthquake may cause to structures. Because an earthquake alters the motion of the ground, which causes foundation failure, the effects of an earthquake are primarily dependent on the type of soil used for building foundations. Therefore, it is crucial to study how different types of soil behave during occurrence of earthquakes. A base isolation technique is one of the methods utilized in construction that can resist earthquakes. It enhances a building's structural performance when it is subjected to lateral stresses. This paper studies the effect of an earthquake response of isolated buildings and provides analysis of the base isolation on the structure's nature as well as a discussion of various isolator types. It compares the performance of two types of isolators: Lead Rubber Bearing (LRB) and Friction Pendulum Bearing (FPB). G+12 R.C structure is taken in this study & Time History analysis is performed with ETABS software. Time Period and Story Stiffness are compared for the building with the base isolator against the building with the fixed base. In comparison with a fixed base building, parameters are changed in each direction due to the presence of an isolator. The analysis examines the characteristics and the effects of base isolation on structures with the Bhuj earthquake.***
Keyword: Seismic analysis, Time history analysis, Lead rubber bearing, Friction pendulum bearing.

I. INTRODUCTION

It is a system that may be defined as flexible or sliding interface positioned between the structure and its foundation, for the purpose of de-coupling its horizontal motion of ground from the horizontal motion of structure so, reducing the earthquake damage to the structure. Base isolation system absorbs and deflects the energy released from the earthquake before it is transferred to the structure.The term isolation refers to the reduced interaction between structure and the ground.Since the seismic isolation system is located under the structure it is referred as Base isolation. The base isolators are used in this system to mitigate the effect of an earthquake by decoupling the components of the building from direct contact with the ground essentiallyisolating the structure from potentially dangerous ground motions.

II. LITERATURE REVIEW

The isolated base system significantly extends the structure's life. When compared to a fixed one, it decreased base shear by up to 75%.The structure's fundamental period is nearly double that of the isolated structure. In seismic analysis, fundamental modes are more effective. The structural performance with isolated base systems outperforms that of a fixed base. The frequency of the isolated base structure has decreased when compared with fixed base building. The story drift is significantly decreased after the installation of base isolators. When compared to non-isolated structure, HDRB, LDRB, and LRB structures reduce storey drift by 13%, 13%, and 15%, respectively, at 9 m height. Lead rubber bearings supersede HDR and LDR bearings in terms of performance. (1)

El Centro Earthquake was used to perform a non-linear time history of a base-isolated, six-story building. SAP2000, a finite element program, was used for the analysis. In the earthquake zone V, a plus-shaped, erratic RC construction was chosen. The isolation systems used in this instance were friction pendulum bearings and lead rubber bearing. For each model, the base shear, duration, and storey displacement were compared. It was discovered that the time period for base isolated structures was increased, minimizing the induced forces caused by earthquakes. The base isolation technique was used to decrease the displacement variation between stories.(2)

It is examined that G+14 R.C.C structure modal analysis. When compared to a fixed base structure with a conventional design, isolated structure decreases story displacement, shear forces, base shear, and inter-story drift.

This demonstrates that effectiveness of base isolation, which is determined that it is better seismic control device. The results show that, in comparison to fixed base structures, isolated base structure decreases shear force by an average of 20 to 25 %. Base Isolation decreases base shear by 44–62%. As a result of the findings presented here, it is possible to conclude that isolated base structure is a enormously efficient seismic control measure.(3)

The study discussed that along with the earthquake response conceptual analysis of isolated base structure and evaluation of a fixed base structure with LRB. Three storey reinforced concrete building is consideration for the study. It established that LRB method is much efficient for sinking lateral behavior of structure so that main parameter extensively controls earthquake reaction of base isolated structure.(4)

III. DETAIL OF MODELLING

In the first model we made fixed base building for G+12 story and in the second modeling we made the Lead rubber isolated building (LRB) for G+12 story and for the third one model we made the Friction pendulum bearing (FPB) of G+12 story.

Table 1. STRUCTURAL CONFIGURATION (IS 456:2000)

S No.	Parameters	Dimension
1.	Grade of steel	Fe 415
2.	Grade of concrete	M20
3.	Storey height	3.2 m
4.	Beam dimension	350×600mm
5.	Column dimension	450×500mm
6.	Wall thickness	230mm
7.	Slab thickness	150mm
8.	Live load on floor	3KN/mm^2

Table 2. SEISMIC PROPERTIES (IS 1893:2016)

1.	Zone	V
2.	Importance factor	1
3.	Damping ratio	5%
4.	Soil profile	Medium soil-II
5.	Response Reduction Factor	5

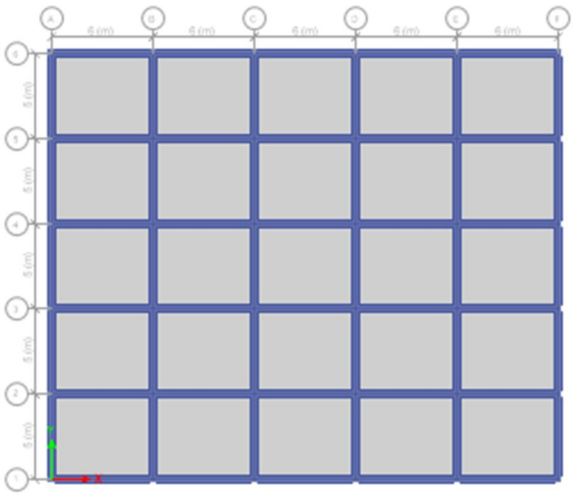


Fig.1- Plan view for (G+12) Building

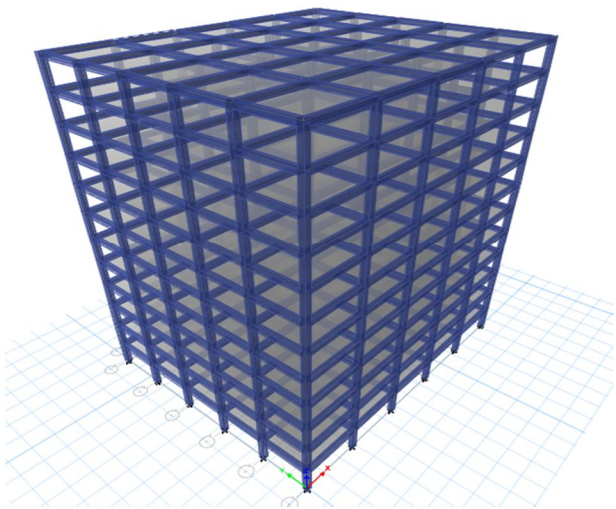


Fig.2 -Elevation view for FB (G+12) Building

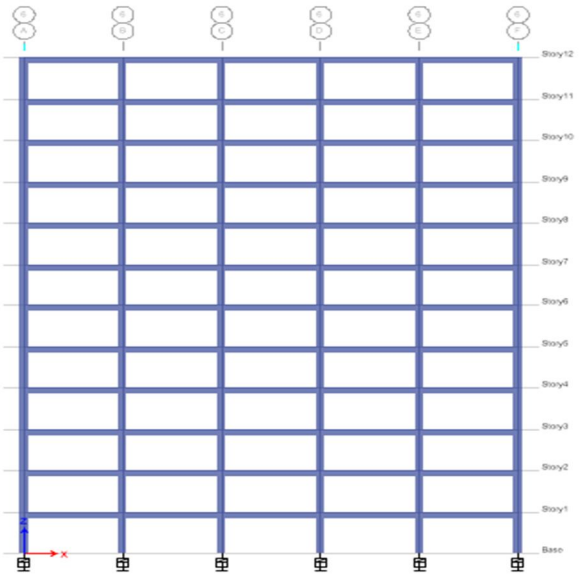


Fig.3- Model for LRB (G+12) Building

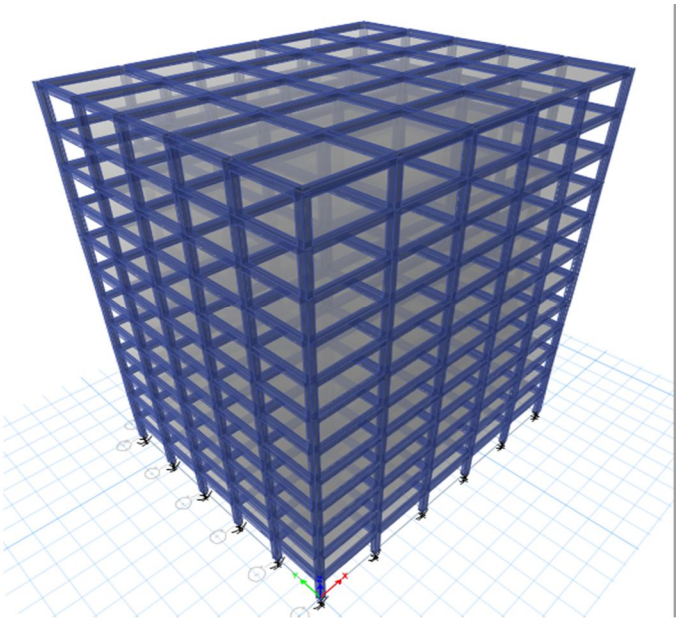


Fig.4-Model for FPS (G+12) Building

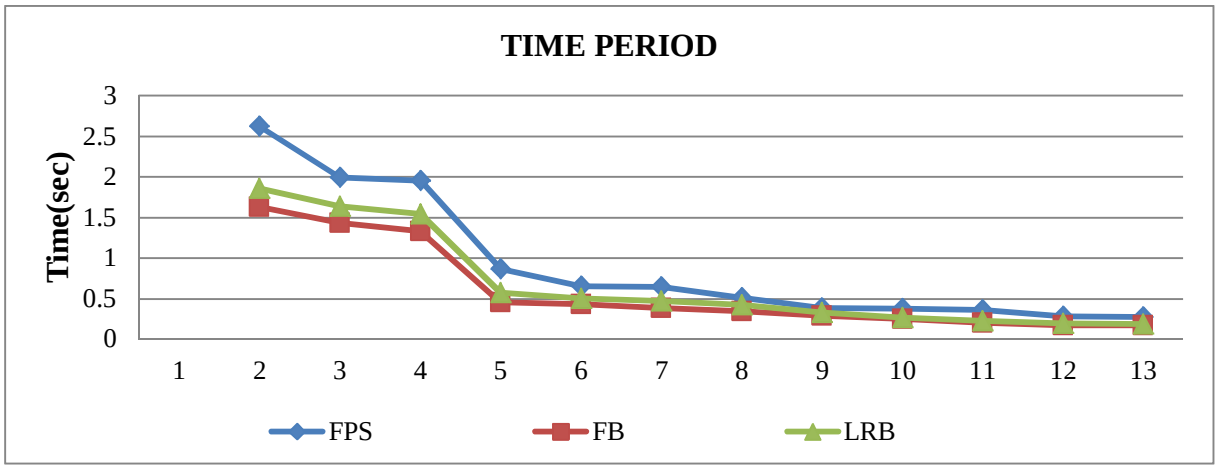
IV. METHODOLOGY

The structure is investigated by developing a three-dimensional concrete framed system. Thirteen stories were sculpted during the analysis process, and the Indian standard (IS) codal regulations were considered. The following sections discuss material properties, building specifications, isolator properties, soil characteristics, and load variations. The following steps need to be taken in order to perform the practical analysis in ETABS. The Bhuj earthquake was aligned to examine time history data.

V. RESULTS AND DISCUSSION

A. Time Period

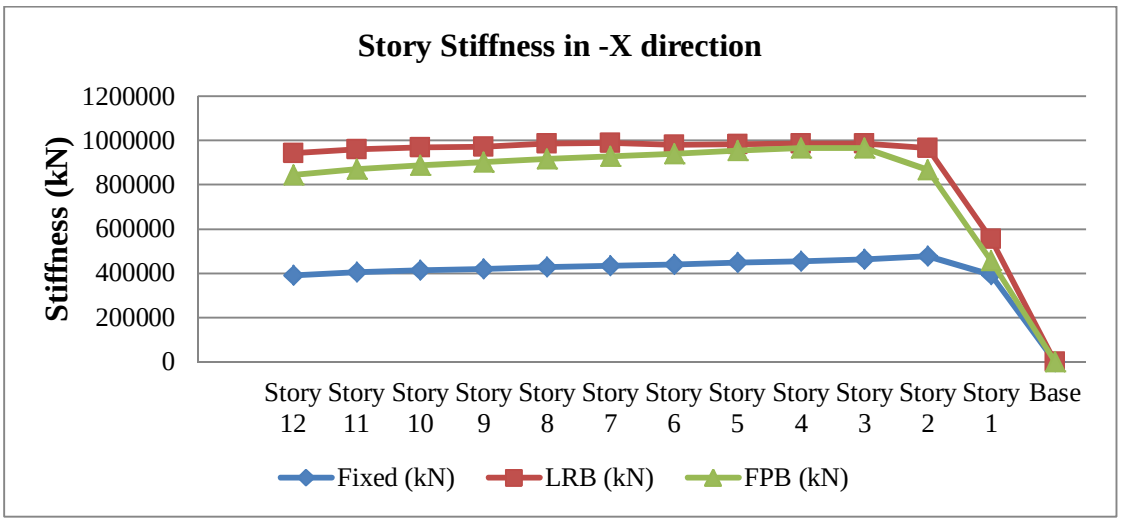
Time period is a function of stiffness and mass, application of the base isolation at the foundation level results in increased flexibility of the structure due to increase in displacement. Time period of structure is defined as time taken to complete one oscillation. The graph shows that the nature of all the models is different after seismic disturbances. Building having Friction pendulum bearing shows the best results of Time period which is 2.52 sec. as compared to the lead rubber bearing and fixed base models i.e.1.86 sec. and 1.63 sec. respectively.



Graph 2. Time Period of Building

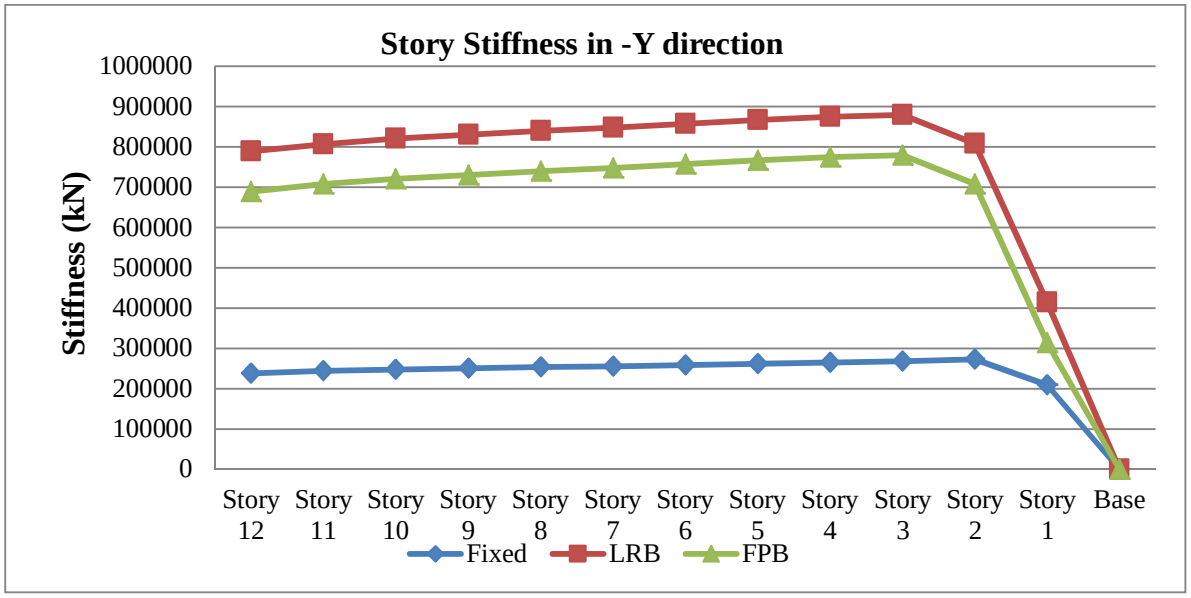
B. Storey Stiffness

The ratio of storey shear to story Drift is describing the lateral stiffness of a story. The variations in the lateral stiffness of a particular story for the various load cases are small enough for normal lateral load distributions to be neglected for frames. The value of Lead Rubber bearing is 944057.2 (kN). as compared to the Friction Pendulum bearing and fixed base models i.e.844054.6 (kN) and 390492.9 (kN) respectively.



Graph 3.Story stiffness graph in X-direction

The above graph shows that the nature of all the models is different after seismic disturbances. Building having Lead rubber bearing shows the best result and gives a maximum value of story stiffness in X direction as compared to other models.



Graph 4.Story stiffness graph in Y-direction

The value of Lead Rubber bearing is 789038.4 (kN). as compared to the Friction Pendulum bearing and fixed base models i.e. 689034.8 (kN) and 238376.2 (kN)respectively. The above graph shows that the nature of all the models is different after seismic disturbances. Building having Lead rubber bearing shows the best result and gives a maximum value of story stiffness in Y direction as compared to other models.

VI. CONCLUSION

1) A tall building with 12 stories with isolated base (FPB & LRB) and fixed base have been analyzed for medium soil conditions. The purpose of the study was to investigate the seismic performance of an isolated base building, according to IS code; the responses of the building, such as story drifts, story forces, time period have been studied. Time history analysis carried out by Etabs software with Bhuj earthquake was done for fixed and isolated base models. After the analysis of the models it can be concluded that;

2) The story stiffness is more in Lead Rubber bearing as compared to Friction Pendulum bearing and fixed base model.

3) The time period is more in Friction Pendulum bearing as compared to other models i.e. Lead Rubber bearing and Fixed Base model

VII.FUTURE SCOPEOF STUDY

A. Study can be performed in Response Spectrum Analysis. Present study is limited to regular shaped building; it can extend to different plan shapes.

B. Effect of base isolation can be investigated on buildings with mass and area irregularity.

C. For base-isolation, new structural components and equipment will continue to be developed,the development of a typical civil engineering materials and techniques, as well as passive energy dissipation & active control systems.

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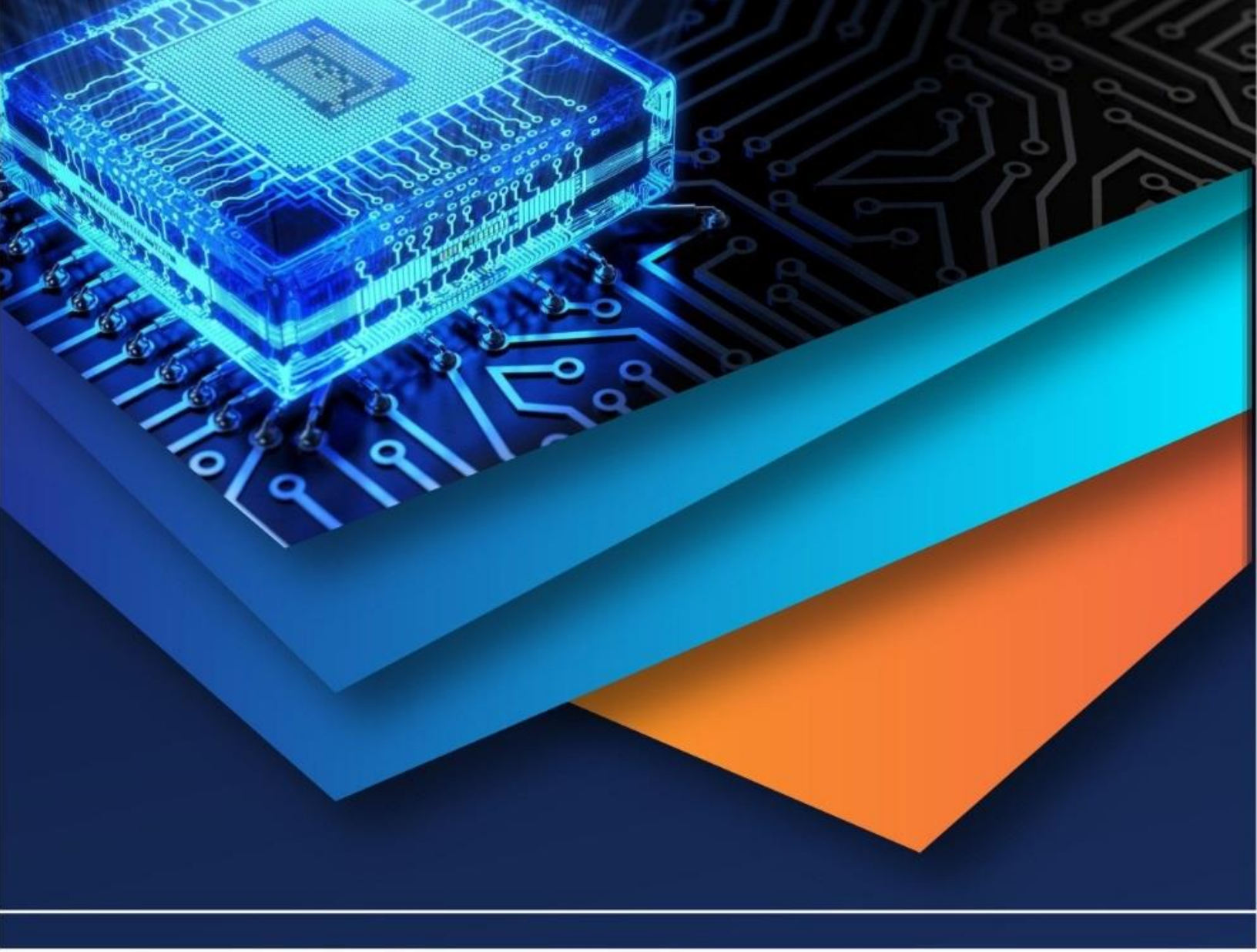

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